

FA-1047

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)

10/018896

INTERNATIONAL APPLICATION NO.

PCT/EP00/05092

INTERNATIONAL FILING DATE

5 JUNE 2000 (05.06.00)

PRIORITY DATE CLAIMED

14 JUNE 1999 (14.06.99)

TITLE OF INVENTION

METHOD FOR REFINISHING DEFECTS IN STOVED ENAMELS WITH POWDER COATINGS

APPLICANT(S) FOR DO/EO/US

RETTIG, Armin et al.

DEC 14 2001

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☒ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to being national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b)) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19<sup>th</sup> month from the earliest claimed priority date.
5. ☒ A copy of the International Application was filed (35 U.S.C. 371 (c) (2))
  - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau.
  - b. ☐ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371 (c) (2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c) (3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409)
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

**Items 13 to 18 below concern document(s) or information included :**

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A FIRST preliminary amendment.  
A SECOND or SUBSEQUENT preliminary amendment.
16. ☐ A substitute specification.
17. ☒ A change of power of attorney and/or address letter.
18. ☒ Certificate of Mailing by Express Mail.
19. ☐ Other items or information:

17. General Power of Attorney

18. Express Mailing Label No.: EJ376014262US

APPLICATION NO. (IF KNOWN SHEET 37(C))		INTERNATIONAL APPLICATION NO. PCT/EP00/05092		ATTORNEY'S DOCKET NUMBER FA-1047	
20. The following fees are submitted				CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :					
<input checked="" type="checkbox"/> Search Report has been prepared by the EPO or JPO				\$890.00	
<input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482)				\$710.00	
<input type="checkbox"/> No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))				\$740.00	
<input type="checkbox"/> Neither international preliminary examination fee paid to USPTO (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO				\$1,040.00	
<input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) And all claims satisfied provisions of PCT Article 33(2)-(4)				\$ 100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).				<input type="checkbox"/> 20 <input type="checkbox"/> 30	\$0.00
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	24 - 20 =	4	x	\$18.00	\$72.00
Independent Claims	1 - 3 =	4	x	\$80.00	\$0.00
Multiple Dependent Claims (check if applicable)				<input type="checkbox"/>	\$0.00
TOTAL OF ABOVE CALCULATIONS =					\$72.00
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable).				<input type="checkbox"/>	\$0.00
SUBTOTAL =					\$0.00
Processing Fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)).				<input type="checkbox"/> 20 <input type="checkbox"/> 30	\$0.00
TOTAL NATIONAL FEE =					\$962.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).				<input type="checkbox"/>	\$0.00
TOTAL FEES ENCLOSED =					\$962.00
				Amount to be : refunded	\$
				Charged	\$
<input type="checkbox"/> A check in the amount of _____ to cover the above fees enclosed. <input checked="" type="checkbox"/> Please charge my Deposit Account No. <u>04-1928</u> in the amount of <u>\$962.00</u> to cover the above fees. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. <u>04-1928</u> a duplicate copy of this sheet is enclosed.					
NOTE : Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (CFR 1.37(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO:					
DESHMUKH, Sudhir G. E. I. DU PONT DE NEMOURS AND COMPANY Legal Patent Records Center 1007 Market Street Wilmington, Delaware 19898 United States of America					
SIGNATURE <u>SEEDHAR</u>					
NAME <u>DESHMUKH, SUDHIR G.</u>					
REGISTRATION NUMBER <u>33,677</u>					
DATE <u>14 DECEMBER 2001</u>					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:

Rettig et al.

Art Unit: UNKNOWN

Serial No.: UNKNOWN

Examiner: UNKNOWN

Filed: Concurrently Herewith

Atty. Docket: FA1047

For: METHOD FOR REFINISHING  
DEFECTS IN STOVED ENAMELS  
WITH POWDER COATINGS

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

**PRELIMINARY AMENDMENT**

It is respectfully requested that the Examiner enter these amendments prior to examination of the above-identified application on its merits. Please amend the application as follows:

**IN THE CLAIMS:**

Please cancel claims 1-9 without prejudice to the Applicants.

Please add new claims 10-33 as follows:

Claim 10. A method of repairing at least one defective area in at least one stoving lacquer coating comprising the steps of:

- (a) applying a powder coating to at least one defective area; and
- (b) melting and curing the powder coating using a near infrared radiation.

Claim 11. The method according to claim 10, further comprising the step of (c) polishing a repaired area.

Claim 12. The method according to claim 10, wherein the at least one stoving lacquer coating is selected from the group consisting of a single-layer

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finishing lacquer coating and a lacquer layer within a multi-layer lacquer coating.

Claim 13. The method according to claim 12, wherein the at least one stoving lacquer coating is selected from the group consisting of an external finishing lacquer layer, a visible color finishing lacquer layer, an effect-giving lacquer layer, a transparent finishing lacquer layer and a visible color and effect-giving finishing lacquer layer.

Claim 14. The method according to claim 10, wherein the at least one stoving lacquer coating is produced from a powder coating.

Claim 15. The method according to claim 14, wherein the at least one stoving lacquer coating is produced from a clear powder coating.

Claim 16. The method according to claim 10, wherein the powder coating is an aqueous powder coat slurry.

Claim 17. The method according to claim 16, wherein the aqueous powder coat slurry has a solids content equal to that of the stoving lacquer layer.

Claim 18. The method according to claim 10, wherein the powder coating is a clear powder coating.

Claim 19. The method according to claim 18, wherein the clear powder coating comprises a binder selected from the group consisting of epoxy-functional (meth)acrylic copolymers having an epoxy equivalent weight of 250 to 700; and a curing agent selected from the group consisting of at least one low molecular weight compound having an average of at least two carboxyl functions per molecule, at least one polymeric compound having an average of at least two carboxyl functions per molecule, anhydrides and combinations thereof.

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- Claim 20. The method according to claim 19, wherein the curing agent is selected from the group consisting of solid aliphatic dicarboxylic acids, anhydrides thereof and combinations thereof.
- Claim 21. The method according to claim 20, wherein the curing agent is dodecanedicarboxylic acid.
- Claim 22. The method according to claim 10, wherein the powder coating composition comprises a heat-curable binder system selected from the group consisting of a self-crosslinking system and an externally crosslinked system.
- Claim 23. The method according to claim 22, wherein the heat-curable binder system is a binder/curing agent combination having at least two reactive functional groups.
- Claim 24. The method according to claim 23, wherein the binder of the binder/curing agent combination is selected from the group consisting of polyester resins, (meth)acrylic copolymers, epoxy resins, phenolic resins, polyurethane resins, siloxane resins and combinations thereof.
- Claim 25. The method according to claim 23, wherein the curing agent of the binder/curing agent combination has a number average molecular mass of 84 to 3000.
- Claim 26. The method according to claim 23, wherein the at least two reactive functional groups are selected from the group consisting of carboxyl groups, epoxy groups, aliphatically bonded hydroxyl groups, aromatically bonded hydroxyl groups, isocyanate groups, blocked isocyanate groups, anhydride groups, primary amino groups, secondary amino groups, blocked amino groups, N-heterocyclic groups capable of ring-opening addition, and combinations thereof.

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Claim 27. The method according to claim 23, wherein the binder/curing agent combination is in a ratio of 98:2 to 50:50.

Claim 28. The method according to claim 10, wherein the powder coating further comprises at least one additive selected from the group consisting of flow agents, degassing agents, antioxidants, light stabilizers, matting agents, color-giving inorganic pigments, color-giving organic pigments, effect-giving inorganic pigments, effect-giving organic pigments, fillers, colorants, adhesion promoters, lubricants, catalysts, rheology-controlling agents, and combinations thereof.

Claim 29. The method according to claim 10, wherein the powder coating has an average particle size ranging from 1 to 40  $\mu\text{m}$ .

Claim 30. The method according to claim 10, wherein the near infrared radiation is in the wavelength ranging from about 760 nm to about 1500 nm.

Claim 31. The method according to claim 30, wherein a near infrared radiator emits radiation over an area or focused along a line or point.

Claim 32. The method according to claim 10, wherein the near infrared radiation is used in combination with heat sources selected from the group consisting of convection ovens and long-wave infrared radiators.

Claim 33. A motor vehicle having at least one stoving lacquer coat repaired according to the method of claim 1.

**IN THE SPECIFICATION:**

Please replace the paragraph beginning at page 2, line 7, with the following rewritten paragraph:

--Methods of repairing defective areas in lacquer layers while avoiding conventional thermal curing by convection or conventional IR irradiation are known from DE-A-38 33 225 and DE-A-197 20 894. The methods described therein use laser light as the energy source for curing of the repair lacquer. DE-

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A-197 20 946 describes a method for repairing defective areas in a stoving lacquer coating, wherein the defective area ready for repair is coated with a lacquer coating composition and the applied lacquer is then cured by irradiation with a laser beam source in the form of a Nd:YAG laser, which produces near infrared radiation.--

Please replace the paragraph beginning at page 3, line 18, with the following rewritten paragraph:

--The invention accordingly provides a method of repairing defective areas in a stoving lacquer coating, which method is characterized in that the defective area ready for repair lacquering is coated with a powder coating composition, and the applied powder coating is then melted and cured by irradiation with near infrared radiation (NIR), which is produced by NIR radiators.-

Please replace the paragraph beginning at page 9, line 19, with the following rewritten paragraph:

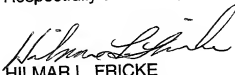
--NIR radiation is short-wave infrared radiation in the wavelength range from approximately 760 to approximately 1500 nm, preferably 760 to 1200 nm. According to the invention there are used conventional high-energy NIR radiators, which are able to emit radiation over an area or focused along a line or at a point. Such NIR radiators are available commercially (for example from Industrie SerVis). They are, for example, high-power halogen radiators with a radiation density of generally more than  $1 \text{ W/cm}^2$ , preferably more than  $10 \text{ W/cm}^2$ , to, for example,  $15 \text{ MW/m}^2$ . The radiators reach, for example, a radiator surface temperature (incandescent coil temperature) of from 2000 to 3000 K. Suitable radiators have, for example, an emission spectrum with a maximum between 750 and 1200 nm.--

#### REMARKS

Claims 1-9 have been cancelled. Claims 10-33 are submitted herewith in a format acceptable to the United States Patent and Trademark Office. If the Examiner has questions regarding the application or the contents of this Preliminary Amendment, the Examiner is invited to contact the undersigned at the number provided.

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Respectfully submitted,



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Date: December 6, 2001

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

In showing the changes, deleted material is shown between brackets, and inserted material is shown as underlined.

**IN THE SPECIFICATION:**

Please replace the paragraph beginning at page 2, line 7, with the following rewritten paragraph:

--Methods of repairing defective areas in lacquer layers while avoiding conventional thermal curing by convection or conventional IR irradiation are known from DE-A-38 33 225[,] and DE-A197 20 894 [and DE-A-197 20 946]. The methods described therein use laser light as the energy source for curing of the repair lacquer. DE-A-197 20 946 describes a method for repairing defective areas in a stoving lacquer coating, wherein the defective area ready for repair is coated with a lacquer coating composition and the applied lacquer is then cured by irradiation with a laser beam source in the form of a Nd:YAG laser, which produces near infrared radiation.--

Please replace the paragraph beginning at page 3, line 18, with the following rewritten paragraph:

--The invention accordingly provides a method of repairing defective areas in a stoving lacquer coating, which method is characterized in that the defective area ready for repair lacquering is coated with a powder coating composition, and the applied powder coating is then melted and cured by irradiation with near infrared radiation (NIR), which is produced by NIR radiators.-

Please replace the paragraph beginning at page 9, line 19, with the following rewritten paragraph:

--[In the method according to the invention, after the powder coating has been applied or after the aqueous powder coating slurry has been applied and dried, the powder coating composition applied to the defective area is melted and cured by irradiation with NIR radiation, preferably with high-intensity NIR radiation. NIR radiation is short-wave infrared radiation in the wavelength range from approximately 760 to approximately 1500 nm, preferably 760 to 1200 nm. According

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to the invention there are used [Radiation sources for NIR radiation are, for example,] conventional high-energy NIR radiators, which are able to emit radiation over an area or focused along a line or at a point. Such NIR radiators are available commercially (for example from Industrie SerVis). They are, for example, high-power halogen radiators with a radiation density of generally more than  $1 \text{ W/cm}^2$ , preferably more than  $10 \text{ W/cm}^2$ , to, for example,  $15 \text{ MW/m}^2$ . The radiators reach, for example, a radiator surface temperature (incandescent coil temperature) of from 2000 to 3000 K. Suitable radiators have, for example, an emission spectrum with a maximum between 750 and 1200 nm.--

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E.I. du Pont de Nemours and Company

Method for the repair lacquering of defective areas in

5 stoving lacquer coatings using powder coatings

The invention relates to the repair lacquering of defects within stoved coating layers using powder coating compositions.

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Lacquer defects, such as, for example, craters, dents, scratches or inclusions of dirt, within stoving coating layers, for example within stoved coating layers produced from powder coatings, can be repaired using liquid

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lacquers. The repair process is costly in terms of time and is labour-intensive. For example, curing of the repair lacquer requires the action of elevated temperatures for a sufficiently long period of time. If the substrates to be repair lacquered are temperature-sensitive substrates, then the object temperature cannot be chosen as high as desired.

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In the case of substrates to be repair lacquered that are composed of a mixture of temperature-sensitive and non-temperature-sensitive components, the temperature-sensitive components are generally removed prior to the action of

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heat, for example in a stoving oven, and are subsequently re-fitted. Such measures hinder series lacquering processes in particular, for example the lacquering of motor vehicles with filler, finishing or clear lacquers, and render them more expensive.

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A particular problem in the repair lacquering, using liquid lacquers, of external, visible stoving finishing lacquers produced from powder coatings is that of carrying out the repair lacquering in such a manner that the repaired area

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is not visually conspicuous, for example in respect of

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colour matching or gloss. In addition, in the case of the repair of stoved clear powder coating layers, the refractive index of the cured clear repair lacquer must not differ substantially from the refractive index of the  
5 stoved clear powder coating.

Methods of repairing defective areas in lacquer layers while avoiding conventional thermal curing by convection or conventional IR irradiation are known from DE-A-38 33 225,  
10 DE-A-197 20 894 and DE-A-197 20 946. The methods described therein use laser light as the energy source for curing of the repair lacquer.

From EP-A-0 842 710 there is known a method of repairing  
15 defective areas in powder coating layers in which a filling body is introduced into the defective area which has been prepared for repair, for example ground or milled out, and is bonded therewith. The filling body preferably corresponds to the dimensions of the prepared defective  
20 area. EP-A-0 887 118 improves the method known from EP-A-0 842 710 in respect of the achievable quality of the repaired defective area, by carrying out the method known from EP-A-0 842 710 in such a manner that the bonding of the filling body and the defective area takes place under  
25 the action of pressure. Although the methods of EP-A-0 842 710 and EP-A-0 887 118 avoid the disadvantages of repairing defective areas in powder coating layers by means of liquid lacquers, they are nevertheless complex because of the necessary preparation of the filling body, especially in  
30 the dimensions adapted to the defective area to be repaired.

In the article "Sekundenschnelle Aushärtung von Pulverlack" [Curing powder coatings in seconds] (Kai Bär, JOT 2/98,

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pages 26 to 29), it is described that powder coatings can be cured with the aid of high-intensity near infrared radiation (NIR) without any substantial heating of the substrate occurring. NIR technology allows powder coatings to be melted and cured in a single process step.

The object of the invention is to provide an improved method for the repair lacquering of defective areas in stoving lacquer coatings, especially within stoving lacquer coatings produced using powder coatings, which method avoids the described disadvantages of the prior art. The method should in particular also be suitable for the repair lacquering of series-lacquered, industrially manufactured articles, especially motor vehicles and parts thereof, for example within the framework of or subsequent to series lacquering.

The invention accordingly provides a method of repairing defective areas in a stoving lacquer coating, which method is characterised in that the defective area ready for repair lacquering is coated with a powder coating composition, and the applied powder coating is then melted and cured by irradiation with near infrared radiation (NIR).

In the method according to the invention, the defective areas, of which there may be one or more, within a stoving lacquer coating, especially within a stoving lacquer coating applied from a powder coating composition, are repair lacquered using a powder coating composition. The stoving lacquer coatings having defective areas may be, for example, single-layer finishing lacquer coatings or lacquer layers arranged within a multilayer lacquer coating, for example primer coats, suface layers and, preferably,

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external, visible colour- and/or effect-giving or, especially, transparent finishing lacquer layers. The method according to the invention can be used preferably in the repair of defective areas within stoved coating layers produced from powder coatings, especially clear powder coatings. The method according to the invention can be used particularly preferably in the repair of defective areas within stoving lacquer coatings applied to motor vehicles and parts thereof.

10 The expression defective areas means that the defective areas in question within stoving lacquer coatings are limited locally, for example are up to several square centimetres in size, for example from 1 mm<sup>2</sup> to 100 cm<sup>2</sup> in size. The defective areas may be, for example, damage such as scratches, for example scratches caused during assembly, flaws in the coating, such as craters or dents, or inclusions of dirt.

15 20 It is pointed out that the powder coating compositions used for the repair lacquering include aqueous preparations of the powder coating compositions, so-called aqueous powder coating slurries. However, powder coatings themselves are preferably used in the method according to the invention.

25 The powder coatings used as repair lacquers in the method according to the invention contain a heat-curable binder system that is self-crosslinking or crosslinks by external means, preferably a binder/curing agent combination that crosslinks by external means. Binder is to be understood as meaning the film-forming higher molecular weight component of a thermosetting powder coating, which generally accounts for at least 50 wt.% of the underlying binder/curing agent combination, while the curing agent component in that

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- combination is generally not more than 50 wt.%. The binder base is in principle not subject to any limitations. For example, conventional binders used for powder coatings are suitable. Examples are polyester resins, (meth)acrylic copolymers, epoxy resins, phenolic resins, polyurethane resins, siloxane resins. The binders have, for example, glass transition temperatures of from 30 to 120°C, preferably below 90°C, and have, for example, number-average molar masses (Mn) of from 500 to 20,000, preferably below 10,000. The curing agents have, for example, number-average molar masses (Mn) of from 84 to 3000, preferably below 2000. Different binders and curing agents can be mixed with one another.
- 15 Binders and curing agents carry mutually complementary reactive functional groups which permit a thermal crosslinking reaction of the powder coating, for example by condensation reactions and/or addition reactions. Examples of such functional groups are carboxyl groups, epoxy groups, aliphatically or aromatically bonded hydroxyl groups, isocyanate groups, blocked isocyanate groups, anhydride groups, primary or secondary amino groups, blocked amino groups, N-heterocyclic groups capable of ring-opening addition, such as, for example, oxazoline groups, (meth)acryloyl groups, CH-acidic groups such as, for example, acetoacetate groups.

- The choice of groups that react with one another is known to the person skilled in the art. Different reactive groups can optionally be combined with one another. That can be effected via binders that carry different reactive functional groups, or mixtures of different curing agents and/or binders are used.

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The different functional groups can be present both in the binder and/or the curing agent. The binders and the curing agents contain on average at least 2 functional groups per molecule. The ratio of binder to curing agent is generally, 5 for example, from 98:2 to 50:50. It is preferably from 95:5 to 70:30.

10 Examples of binder/curing agent systems conventional in powder coatings are polyester resins with low molecular weight epoxy or hydroxyalkylamide curing agents, epoxy/polyester hybrid systems, epoxy resins with dicyanodiamide curing agents, carboxylic acid curing agents or phenolic curing agents, hydroxy-functional polyesters or (meth)acrylic copolymers with blocked polyisocyanates, 15 epoxy-functional (meth)acrylic copolymers with carboxylic acid or carboxylic anhydride curing agents.

In particular in the case of the repair of defective areas in external, visible, stoved clear lacquer coatings, the 20 repair lacquers used in the method according to the invention are preferably clear powder coatings that contain epoxy-functional (meth)acrylic copolymers, especially glycidyl (meth)acrylate copolymers having an epoxy equivalent weight of from 250 to 700, as binders, and one 25 or more low molecular weight and/or polymeric compounds having on average 2 or more carboxyl functions per molecule, and/or anhydrides thereof, as curing agents. Preferred curing agents are solid aliphatic dicarboxylic acids and/or anhydrides thereof such as, especially, 30 dodecanedicarboxylic acid, which may also be used in admixture with carboxyl-functional polyesters.

The powder coatings used in the method according to the invention can contain conventional powder coating additives

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in conventional amounts of, for example, from 0.1 to 5 wt.%. Examples of such additives are flow agents, degassing agents such as, for example, benzoin, antioxidants, light stabilisers, matting agents, colour- and/or effect-giving  
5 inorganic and/or organic pigments and/or fillers, colourants, adhesion promoters, lubricants, catalysts as well as rheology-controlling agents.

If opacifying pigments or effect pigments are used, then  
10 the powder coating compositions in question can be used for repairing defective areas in colour- and/or effect-giving lacquer layers. If no pigments or colourless pigments, for example micronised titanium dioxide or silicon dioxide, are used, then the clear powder coating compositions in  
15 question can be used for repairing defective areas in clear lacquer layers.

The preparation of the powder coatings used as the repair lacquer in the method according to the invention can take  
20 place according to the conventional methods for the preparation of powder coatings, for example by extrusion of the powder coating, ready formulated by dry mixing of all the necessary components, in the form of a pasty melt, cooling of the melt, coarse comminution, fine milling and,  
25 optionally, subsequent sieving to the desired fineness of grain, for example to mean particle sizes of from 10 to 90  $\mu\text{m}$ .

The method according to the invention can be carried out  
30 using fine-grained powder coating, for example having mean particle sizes of from 1 to 40  $\mu\text{m}$ . Fine-grained powder coating or powder coating fine grain can be prepared in a targeted manner, but it is obtained as undesired material during, for example, the production of powder coatings or

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during the application of powder coatings and can therefore usefully be employed in the method according to the invention.

- 5 The powder coatings can also be used in the form of aqueous powder coating slurry. To that end they can be converted, for example, by dry or wet milling or by intensive dispersion of a powder coating melt or an organic powder coating solution in water into an aqueous powder coating  
10 slurry, which can optionally be freed of organic solvent by distillation.

- The powder coatings used in the method according to the invention preferably have the same solids composition as  
15 the lacquer previously used to produce the stoving lacquer layer having defective areas that is to be repaired. The repair in question is preferably the repair of defective areas in stoved powder coating layers. In that case, powder coatings having an identical composition are used both in  
20 the initial lacquering and in the repair lacquering according to the invention. That is particularly advantageous in the repair of defective areas in external, visible, stoved clear lacquer layers. For example, there is then no difference between the intrinsic colour and the  
25 refractive index of the initial lacquer coating and those of the repair lacquer coating.

- In the method according to the invention, defective areas in a stoving lacquer coating are repaired using powder  
30 coatings as the repair lacquers. The defective areas may be ready for immediate repair lacquering, or they are prepared for the repair lacquering, for example by grinding, milling or treatment of the defective areas with a laser. In general, the defective areas are at least cleaned before

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the powdered repair lacquer is applied. It is also expedient to protect the defect-free coated portions of the surface from contamination, for example by covering them, masking them or by applying a removable lacquer around the defective areas to be repaired.

Regardless of whether the defective areas ready for the repair lacquering are located on horizontal or vertical surfaces, they can be coated with the powder coating composition, for example, mechanically, for example by sprinkling, brush application or application by painting, or application is effected by spraying using the application devices conventionally employed for that purpose. Mechanical application is suitable especially for fine-grained powder coating material. Spray application can be, for example, electrostatically assisted, for example with the aid of corona or tribo spray devices.

In the method according to the invention, after the powder coating has been applied or after the aqueous powder coating slurry has been applied and dried, the powder coating composition applied to the defective area is melted and cured by irradiation with NIR radiation, preferably with high-intensity NIR radiation. NIR radiation is short-wave infrared radiation in the wavelength range from approximately 760 to approximately 1500 nm, preferably from 760 to 1200 nm. Radiation sources for NIR radiation are, for example, conventional high-energy NIR radiators, which are able to emit radiation over an area or focused along a line or at a point. Such NIR radiators are available commercially (for example from Industrie SerVis). They are, for example, high-power halogen radiators with a radiation density of generally more than  $1 \text{ W/cm}^2$ , preferably more than  $10 \text{ W/cm}^2$ , to, for example,  $15 \text{ MW/m}^2$ . The radiators reach,

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for example, a radiator surface temperature (incandescent coil temperature) of from 2000 to 3000 K. Suitable radiators have, for example, an emission spectrum with a maximum between 750 and 1200 nm.

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The irradiation time in the method according to the invention is, for example, from 1 to 300 seconds. During irradiation, the powder coating applied in order to repair the defective area melts and cures, for example, within  
10 from 1 to 300 seconds, preferably within from 5 to 60 seconds.

The irradiation can be carried out in a belt apparatus equipped with one or more NIR radiators, or using a NIR  
15 radiator, which is positioned in front of the object or the area to be irradiated.

The first-mentioned possibility is suitable, for example, in the repair lacquering of individual parts or of objects  
20 in which a plurality of defective areas is to be repaired in one step. The belt speed, and hence the irradiation time, can be varied. For example, belt speeds of from 1 to 7 m/minute can be set, which may correspond, for example, to irradiation times of from 2 to 20 seconds. The distance  
25 between the NIR radiator and the surface of the object can be, for example, from 1 to 60 cm, preferably from 4 to 20 cm.

In the case of the second possibility, the NIR radiator is  
30 positioned in front of the object or the area to be irradiated. The irradiation time can be, for example, from 1 to 300 seconds, and the distance to the object can be, for example, from 1 to 60 cm, preferably from 4 to 20 cm.

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The various irradiation parameters, such as the belt speed or irradiation time, the distance from the object, the radiation capacity of the NIR radiator used, can be adapted by the person skilled in the art according to the requirements of the particular repair task in question.

It is also possible to use for the curing a combination of NIR irradiation and the supply of heat by means of conventional heat sources such as convection ovens or usual longer-wave infrared radiators.

After curing by NIR irradiation of the powder coating applied in order to repair defective areas, it may be expedient to smooth the repaired area, for example by polishing.

By means of the method according to the invention it is possible to repair defective areas in single-layer stoving lacquer coatings. It is also possible using the method according to the invention to repair defective areas in a stoving lacquer layer arranged within a multilayer lacquer coating. At least two cases can be distinguished:

1. Application of one or more lower (closer to the substrate) lacquer layers, optional drying or curing thereof, application according to the invention of repair powder coating (or aqueous repair powder coating slurry), melting and curing of the (dried) powder coating layer by NIR irradiation, optional covering with further coating layers. In the case, for example, of a defective area that is to be repaired within a clear lacquer layer of a colour- and/or effect-giving base lacquer-clear lacquer two-layer lacquer coating, first the colour- and/or effect-giving base lacquer layer can be applied from a

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base lacquer coating composition to the defective area of the stoving lacquer coating ready for repair lacquering, that layer can optionally be exposed to air and/or stoved, and then a clear powder coating can be applied and melted and cured by NIR irradiation.

- 5
2. Application according to the invention of repair powder coating (or repair powder coating slurry), melting and curing of the (dried) powder coating layer by NIR irradiation, optional covering with further coating layers. In the case, for example, of a defective area within a surfacer layer that is to be repaired, a powder surfacer is applied and melted and cured by NIR irradiation before, for example, being covered with base lacquer and clear lacquer. For example, covering with base lacquer and clear lacquer can take place within the framework of the initial lacquering or within the framework of a repair lacquering carried out on the finished initially lacquered object. Another example is a defective area that is to be repaired within a clear lacquer layer of a colour- and/or effect-giving base lacquer-clear lacquer two-layer lacquer coating. In that case, a clear powder coating can be applied to the defective area ready for repair, for example a defective area that has not been ground out to the base lacquer layer or even further, and melted and cured by NIR irradiation.
- 10
- 15
- 20
- 25

The method according to the invention permits the repair lacquering of defective areas in stoving lacquer coatings, especially within stoving lacquer coatings produced using powder coatings. The disadvantages of the prior art mentioned at the beginning can be avoided. The method is suitable for the repair lacquering of series-lacquered, industrially manufactured articles; it is suitable

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especially for the repair of defective areas within powder coating layers, especially finishing and clear powder coating layers, produced within the framework of the series lacquering of motor vehicles or motor vehicle parts.

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#### Example

On an engine bonnet having a typical series lacquering structure of cathodically deposited primer coat, surfacer layer, base lacquer layer and, finally, clear powder coating layer, there is a particle of dirt within the clear powder coating layer.

The particle of dirt is removed by grinding, without penetrating the base lacquer layer. A defective area approximately  $0.5 \text{ cm}^2$  in size and ready for repair is formed in the clear powder coating layer. The region to be repaired is isolated from the defect-free surface by masking with heat-stable film.

20

The same clear powder coating as that previously used to produce the initial lacquer coating is applied by electrostatic spraying to the defective area ready for repair.

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A NIR radiator from Industrie SerVis is positioned at a distance of 100 mm from the defective area coated with the clear powder coating. Irradiation is carried out for 8 seconds with a capacity of  $400 \text{ kW/m}^2$ , during which time the clear powder coating melts and cures completely.

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The covering film is then removed and the small area of the repaired area is polished using a commercial grinding paste.

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E.I. du Pont de Nemours and Company

Patent claims:

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1. Method of repairing defective areas in a stoving lacquer coating, characterised in that the defective area ready for repair lacquering is coated with a powder coating composition or with an aqueous powder coating slurry, and  
10 the applied powder coating is then melted and cured by irradiation with near infrared radiation (NIR).

15

2. Method according to claim 1, characterised in that it is carried out in order to repair defective areas within  
15 stoved coating layers produced from powder coatings.

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3. Method according to claim 1 or 2, characterised in that it is carried out in order to repair defective areas within stoving lacquer coatings applied to motor vehicles  
20 and parts thereof.

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4. Method according to any one of claims 1 to 3, characterised in that it is carried out in order to repair defective areas in external, visible, stoved clear  
25 lacquer layers.

30

5. Method according to any one of claims 1 to 4, characterised in that the defective areas are prepared for the repair lacquering, especially by grinding,  
30 milling, treatment of the defective areas with a laser, and/or cleaning.

6. Method according to any one of claims 1 to 5, characterised in that the irradiation is carried out

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using NIR radiation in the wavelength range from 760 to 1500 nm.

7. Method according to any one of claims 1 to 6,  
5 characterised in that there are used NIR radiators which, in order to adapt to the defective area to be repaired, are able to emit radiation over an area or focused along a line or at a point.
- 10 8. Method according to any one of claims 1 to 7, characterised in that the NIR irradiation is carried out in combination with conventional heat sources.
- 15 9. Method according to any one of claims 1 to 8, characterised in that it is carried out using a powder coating or an aqueous powder coating slurry having the same solids composition as the lacquer previously used to produce the stoving lacquer layer having defective areas that is to be repaired.

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## DECLARATION and POWER OF ATTORNEY

FA-1047

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

the specification of which is attached hereto unless the following box is checked:

☒ was filed on 05.06.2000 as U.S. Application No. \_\_\_\_\_ a PCT International Application No. EP00/05092 and was amended on 02.08.2001 (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known to me to be material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Application No.	Country	Filing Date	Priority Claimed (Yes/No)
199 27 041.4	DE	14.06.1999	yes

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States Provisional Application(s) listed below.

U.S. Provisional Application No. \_\_\_\_\_ U.S. Filing Date \_\_\_\_\_

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International Application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application or PCT International Application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is known to me to be material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

Application No.	Filing Date	Status (patented, pending or abandoned)

**POWER OF ATTORNEY:** I hereby appoint the following attorney(s) and/or agent(s) the power to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Name:	Registration No.:
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

## INVENTOR(S)

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**GENERAL POWER OF ATTORNEY**  
(Concerning Several International Patent Applications)

The undersigned, Vernon R. Rice, Vice President and Assistant General Counsel of E. I. DU PONT DE NEMOURS AND COMPANY, 1007 Market Street, Wilmington, Delaware 19898 USA ("DuPont"), hereby confirms that the power to sign for DuPont has been granted to various individuals (as set forth in the attached excerpt from DuPont's Patent Board Rules of Procedure (January 1988), Appendix Section III.A.4), including the Chairman, Vice-Chairman, and those individuals who are Assistant Secretaries of the Patent Board. Currently these Assistant Secretaries are:

Roger A. Bowman  
Linda J. Davis  
John E. Griffiths

Barbara J. Massie  
Miriam D. McConnahey  
Deborah A. Meginniss

In addition, the authority to act on behalf of DuPont before the competent International Authorities in connection with any and all international patent applications filed by it with the United States as Receiving Office and to make or receive payments on its behalf is hereby granted to:

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Belopolsky, Inna	43,319	Kelly, Patricia L.	39,247
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Birch, Linda D.	38,719	Kuller, Mark D.	31,925
Bowen, Jr., Alanson G.	24,027	Krukiet, Charles E.	27,344
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Furr, Robert B.	32,985	Shay, Lucas K.	34,724
Golian, Andrew G.	25,293	Shipley, James E.	32,003
Golian, Paul D.	42,591	Siege, Barbara C.	30,684
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Gould, David J.	25,338	Steinberg, Michael A.	43,160
Griffiths, John E.	32,647	Steinberg, Thomas W.	37,013
Hamby, Jane O.	32,872	Stevenson, Robert B.	26,039
Hamby, William H.	31,521	Strickland, Frederick D.	39,041
Heiser, David E.	31,366	Tulloch, Rebecca W.	36,297
Hendrickson, John S.	30,847	Walker, P. Michael	32,602
Joung, J. Kenneth	41,881	Wang, Chen	38,550

The undersigned ratifies fully all actions already taken by the above-named individuals in accordance with the authority granted hereby.

E. I. DU PONT DE NEMOURS AND COMPANY

By: *Vernon R. Rice*

Vernon R. Rice  
Vice President and Assistant General Counsel

0. 9. 01

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Application of:

ARMIN RETTIG, ET AL.

CASE NO.: FA1047

APPLICATION NO.: UNKNOWN

GROUP ART UNIT:

FILED: CONCURRENTLY HERewith

EXAMINER:

FOR: METHOD FOR REFINISHING DEFECTS IN  
STOVED ENAMELS WITH POWDER  
COATINGS

**ASSOCIATE POWER OF ATTORNEY**

Assistant Commissioner for Patents  
Washington, DC 20231


Sir:

I hereby appoint HILMAR L. FRICKE (Registration No. 22,384) as associate attorney in the above-entitled application, to prosecute this application, to make alterations and amendments therein, to inspect the file, and to transact all business in the Patent and Trademark Office connected therewith.

Please address all future communications to the above-appointed associate attorney of record at the following new address:

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